ENGINEERING DOCUMENT CHANGE CONTROL

HPCM0731

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☐ Direct Revision ☐ Supplemental Change ☐ Page Change
☐ Supersedure ☐ Cancel/Void ☒ New

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☒ Major ☐ Minor ☐ Conf Baseline

3. Date: 10/01/2002

4. Originator's Name, Organization, MSIN, and Telephone No.:
DS Mantooth, Fluor Hanford, L1-08, 376-6842

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5. USQ Required? ☐ Yes ☒ No USQ No.: _____ CX No.: N/A

6. Technical Authority: DS Mantooth

7. Project/Program (WMP, FFTF, etc.): RCP

8. Area: N/A

9. Building: N/A

10. Reviewer Designator: R, Q

11. Plan:
The document will be developed by the FTA, Workplace Air Sampling. The electronic calculation tool will be independently verified. The final document will be approved by the CP QA Representative.

12. Criteria:
Document must meet the software QA requirements applicable to spreadsheet calculation tools.

13. Change Description:
A spreadsheet calculation tool developed to automate calculations performed for determining the concentration of airborne radioactivity. This document reports on the design and testing of the calculational tool.

14. Documents Issued or Changed by this EDC:

Document	Page	Revision	Comments
HNF-12661		0	Air Sample Calculation Tool for CPRP

15. Technical Justification (Need):
A software QA Plan is required for calculations performed by electronic spreadsheets.

Evaluation and Coordination

16. Change Impact:
N/A

17. Affected Documents:

Document Number	Page	Revision	Person Notified/Comments
N/A			

ENGINEERING DOCUMENT CHANGE CONTROL (continued)

Verification

18. Verification:

See Block 11, Plan.

19. Approvals/Reviews:

Initials, Last Name, Date, MSIN	Initials, Last Name, Date, MSIN
Technical Authority: DS Mantooth 10/1/02	Technical Authority Manager: SL Bump 10/1/02 LI-08
Reviewer (Title): Quality Assurance DG Farwick 10/1/02	Reviewer (Title): Health Physicist DN (Don) Stewart 10-1-02
Reviewer (Title):	Reviewer (Title):
Reviewer (Title):	Reviewer (Title):
Reviewer (Title):	Reviewer (Title):

Solution

20. Change Description (Solution) - Continuation Sheet:

DISTRIBUTION SHEET

To	From	Page 1 of 1
DISTRIBUTION	DS Mantooth	Date 10/01/2002
Project Title/Work Order		EDT No. EDC-02-12662
Air Sample Calculation Tool for the Central Plateau Remediation Project		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
SL Bump	L1-08	X			
DG Farwick	L1-06	X			
BL Baumann	H5-26	X			
DN Stewart	L1-08	X			
DS Mantooth	L1-08	X			
Central Files	B1-07	(Orig.)			

HNF-12661
Revision 0

Air Sample Calculation Tool for the Central Plateau Remediation Project

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Richland, Washington

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Air Sample Calculation Tool for the Central Plateau Remediation Project

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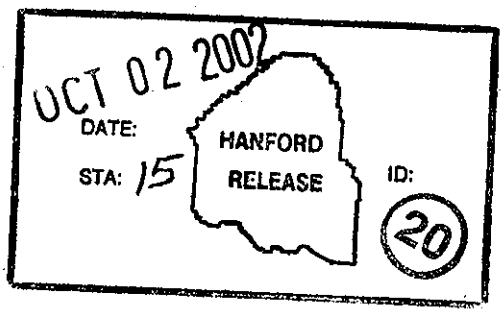

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Total Pages 16

ABSTRACT

A spreadsheet calculation tool was developed to automate the calculations performed for determining the concentration of airborne radioactivity This document reports on the design and testing of the calculation tool.

KEY WORDS: Airborne Radioactivity, calculation tool, spreadsheet, workplace air sampling.

CONTENTS

AIR SAMPLE CALCULATION TOOL FOR THE CENTRAL PLATEAU PROJECT

1.0 Introduction

This document provides a description of and testing results for a spreadsheet calculation tool that will automate the calculations for determining the concentration of radionuclides in air.

Radiological Control Technicians (RCTs) will save time and reduce hand written and calculation errors by using an electronic form for documenting and calculating work place air samples. Current expectations are HPTs will perform an air sample, collect the filter, survey the filter for gross alpha and beta/gamma radioactivity and with the gross counts utilize either hand calculation method or a calculator to determine activity on the filter. The electronic form will allow the HPT with a few key strokes to document the individual's name, payroll, gross counts, instrument identifiers; produce an error free record. This productivity gain is realized by the enhanced ability to perform mathematical calculations electronically (reducing errors) and at the same time, documenting the air sample.

2.0 CALCULATION TOOL DESIGN AND DESCRIPTION

The air sample calculation tool is shown in Appendix A

2.1 System Requirements

The spreadsheet calculation tool will normally be used by RCTs who have need to calculate the concentration of radionuclides in air from air sample analytical results. The tool must include all the required data and perform necessary calculations required on Form A-6002-167, or equivalent per HNF-PRO-7667.

2.1.1 Constraints

This spreadsheet calculation tool is a stand-alone product that can be used on any PC system with Microsoft Excel Version 2000 or greater . This spreadsheet calculation tool is only for use in calculation of radionuclide activity in air.

2.1.2 Input and Output Parameters

The input data consists of the air sample analysis results, counting instrument parameters, and administrative information required on the standard Air Sample Counting Log (A-6002-167). The results of the electronic calculations (output) are inserted real-time into the appropriate blanks on the spreadsheet. A hardcopy of the completed spreadsheet must be printed to be signed by the RCT completing the calculations. The spreadsheet input and output parameters are summarized in Table 1.

Table 1 Input and Output Parameters

Input	Output
Instrument identification number, Model No., and Calibration Expiration Date*	
Detector identification number*	
Counting efficiency, E_c*	Alpha Correction Factor = $1/E_c$
Background counts, N_b*	
Background counting time, T_b*	Background Alpha Count Rate = $R_b = N_b \div T_b$
Counter Location*	
Sample No.	
Sample Location	
Filter Media using the pull-down	Returns an error message if incorrect filter code is used. Automatically chooses the correct filter efficiency, E_f
Sample start Date, time, and Flow (cubic feet per min)	Returns and error message if incorrect format is used
Sample Counting Time, T_g*	Decision Level = $D_L = 1.645(R_b(1/T_g + 1/T_b)^{1/2}$
	Minimum Detectable Concentration, MDC = $(2.71+3.29(R_bT_g(1+T_g/T_b))^{1/2}) \div (6.29E+10E_cE_fT_gT_sF)$
Gross Sample Counts (sample + background), N_g*	Count Rate, $R_n = (N_g/T_g) - R_b = R_g - R_b$
	Sample Activity, uCi/mL = $R_n \div (6.29E+10E_cE_fT_sF)$
	Counting Error, $\sigma = (R_g/T_g + R_b/T_b)^{1/2} \div (6.29E+10E_cE_fT_sF)$
	No. DAC = (Sample Activity÷uCi/mL/DAC) + 1.645 σ

*Input Data must be provided for both alpha and beta counts

2.1.3 Interface Requirements

There are no interface requirements for this spreadsheet calculation tool.

2.1.4 Transferability

The tool will be opened from Hanford Site Forms as needed. There is no practical limit on the number of copies that may be opened at a single time.

2.1.5 Installation

The user must be able to access a computer with MicroSoft Exel and the tool installed.

3.0 SPREADSHEET TESTING

The operation of the spreadsheet calculation tool was tested utilizing four test cases. Hand calculations (using a Hewlett Packard 11c calculator) for each test case were compared with the results provide the calculation tool. The test case parameters are shown in Appendix B and the comparison between the hand electronic calculations are provided in Appendix C. The actual hand calculation sheets are maintained in the history file for this document. The tests demonstrate that the tool performs appropriately.

4.0 CONFIGURATION CONTROL

4.1 Software Documentation Change Control

The spreadsheet calculation tool will be placed under the control of Hanford Site Forms. Each version or revision of the tool will be uniquely identified. Software acceptance will be performed, as necessary, for changes.

4.2 Change Control

Access to the spreadsheet for the purpose performing additions or revisions requires a unique password. Control of the password will be the responsibility of the spreadsheet custodian. The custodian will receive and incorporate user requests for changes into subsequent revisions to the software, as appropriate. The revised calculation tool will have the new version number added to the title of the spreadsheet. The new revision will be tested in the manner described in Section 3.0.

The spreadsheet custodian will maintain a record copy of the spreadsheet calculation tool.

5.0 CONCLUSIONS

A spreadsheet calculation tool was developed to automate the calculations required to determine the concentration of airborne radionuclides. The test results indicate that the spreadsheet calculation tool performs as it was designed.

6.0 REFERENCES

HNF-PRO-7667, *Analyzing Air And Smear Samples*

APPENDIX A

TOOL FOR CALCULATION AIR SAMPLE RESULTS

CENTRAL PLATEAU AIR SAMPLING ANALYSIS RECORD

Log No.: _____ Page: of _____ of _____

Counter	Counting Equipment Data: Model	Inst. ID	Cal. Due Date	Detector ID	Det. Cal Due	E_s (cpm/dpm): α	βγ	Background Data: α N_b	α T_b	α R_b	βγ N_b	βγ T_b	βγ R_b	Location
1						0.345	0.310	1	20	0.05	1000	20	50.00	
2						0.345	0.310	3	20	0.15	1000	20	50.00	
3														
4														
5														

Smpl	Sample Description *	Survey Number	Media Type**	On: Date/Time/Flow	Off: Date/Time/Flow		Counter		T_s (Min)	DL (cpm)	MDC (μCi/ml)	N_s (counts)	R_n (cpm)	Activity (μCi/ml)	σ (μCi/ml)	DAC Fraction	Init. Payr. #
1	Test Case 1		V	01/01/2002	08:00	2.00	α	1	10	0.142	1.33E-15	3	0.25	5.96E-16	4.30E-16	0.001	
				01/08/2002	08:00	2.00	βγ	1	10	4.505	2.46E-14	750	25.00	6.64E-14	8.39E-15	0.000	
2	Test Case 2		F	01/01/2002	00:00	2.00	α	1	10	0.142	8.13E-15	3	0.25	3.66E-15	2.64E-15	0.004	
				01/02/2002	02:15	2.00	βγ	1	10	4.505	1.51E-13	750	25.00	4.07E-13	5.15E-14	0.000	
3	Test Case 3		P	01/01/2002	00:00	40.00	α	1	10	0.142	9.99E-14	20	1.95	3.50E-13	8.08E-14	0.242	
				01/01/2002	00:15	40.00	βγ	1	10	4.505	8.79E-13	13125	1262.50	1.20E-10	1.10E-12	0.061	
4	Test Case 4		V	01/01/2002	08:00	2.00	α	2	10	0.247	1.82E-15	2	<DL	N/A	N/A	N/A	
				01/08/2002	08:00	2.00	βγ	2	10	4.505	2.46E-14	530	<DL	N/A	N/A	N/A	
							α										
							βγ										
							α										
							βγ										
							α										
							βγ										
							α										
							βγ										

* If Recount, Specify Time.

Note: Underlined Values indicate out of bound condition

DAC Concentration used:

Alpha: 2.00E-12 (Default - 2.00E-12)

Beta: 2.00E-09 (Default - 2.00E-09)

Planchet Self Absorbtion Coefficient (E_a):

(Ea = 1.0 for all other Media Types.)

Alpha: 0.45 (Default - 0.45)

Beta: 0.95 (Default - 0.95)

**Media Type	E_f
F = Fluoropore	0.9999
V = Versapore	0.9584
P = Planchet	0.9500
L = LB 5211	0.9997

Counted By: _____ / _____ Date: _____
Name/Payroll No. Signature

_____ / _____ Date: _____
Name/Payroll No. Signature

_____ / _____ Date: _____
Name/Payroll No. Signature

Log Reviewed by: _____ / _____ Date: _____
Name/Payroll No. Signature

APPENDIX B

VALIDATION TEST CASES AND RESULTS FOR THE CALCULATION TOOL

TEST CASE 1 INPUT PARAMETERS

	Alpha	Beta
E_c	0.345	0.31
E_f	0.95	0.95
N_b	1	1000
T_b	20	20
N_g	3	750
T_g	10	10
Time On	01/01/02 08:00	01/01/02 08:00
Time Off	01/08/02 08:00	01/08/02 08:00
Filter	Versapore	Versapore
E_A	1.0	1.0
F	2 CFM	2 CFM

TEST CASE 2 INPUT PARAMETERS

	Alpha	Beta
E_c	0.345	0.31
E_f	1.0	1.0
N_b	1	1000
T_b	20 min	20 min
N_g	3	750
T_g	10 min	10 min
Time On	01/01/02 00:00	01/01/02 00:00
Time Off	01/02/02 02:15	01/02/02 02:15
Filter	Fluorapore	Fluorapore
E_A	1.0	1.0
F	2 CFM	2 CFM

TEST CASE 3 INPUT PARAMETERS

	Alpha	Beta
E_c	0.345	0.31
E_f	0.95	0.95
N_b	1	1000
T_b	20 min	20 min
N_g	20	13,125
T_g	10 min	10 min
Time On	01/01/02 00:00	01/01/02 00:00
Time Off	01/01/02 00:15	01/01/02 00:15
Filter	Planchet	Planchet
E_A	0.45	0.95
F	40 CFM	40 CFM

TEST CASE 4 INPUT PARAMETERS

	Alpha	Beta
E_c	0.345	0.31
E_f	0.95	0.95
N_b	3	1000
T_b	20	20
N_g	2	530
T_g	10	10
Time On	01/01/02 08:00	01/01/02 08:00
Time Off	01/08/02 08:00	01/08/02 08:00
Filter	Versapore	Versapore
E_A	1.0	1.0
F	2 CFM	2 CFM

APPENDIX C
HAND CALCULATIONS AND RESULTS SUMMARY

TEST CASE RESULTS SUMMARY

Parameter		Formula	Results							
			Case 1		Case 2		Case 3		Case 4	
			Hand Calc	Tool	Hand Calc	Tool	Hand Calc	Tool	Hand Calc	Tool
R_b	α	N_b/T_b	0.05	0.05	0.05	0.05	0.05	0.05	0.15	0.15
	β/γ		50	50	50	50	50	50	50	50
DL	α	$1.645\sqrt{R_b\left(\frac{1}{T_g}+\frac{1}{T_b}\right)}$	0.142	0.142	0.142	0.142	0.142	0.142	0.247	0.247
	β/γ		4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.51
MDC	α	$\frac{2.71+3.29\sqrt{R_bT_g\left[1+T_g/T_b\right]}}{6.29E+10E_cE_fE_AT_sT_gF}$	1.33E-15	1.33E-15	8.13E-15	8.13E-15	9.99E-14	9.99E-14	1.82E-15	1.82E-15
	β/γ		2.46E-14	2.46E-14	1.51E-13	1.51E-13	8.79E-13	8.79E-13	2.46E-14	2.46E-14
R_n	α	$N_g/T_g - R_b = R_s - R_b$	0.25	0.25	0.25	0.25	1.95	1.95	0.05 (<DL)	<DL
	β/γ		25	25	25	25	1263	1263	3.0 (<DL)	<DL
Act.	α	$\frac{R_n}{6.29E+10E_cE_fE_AT_sF}$	5.96E-16	5.96E-16	3.66E-15	3.66E-15	3.50E-13	3.50E-13	N/A	N/A
	β/γ		6.64E-14	6.64E-14	4.07E-13	4.07E-13	1.20E-10	1.20E-10	NA	NA
Error, σ	α	$\frac{\sqrt{R_s/T_g+R_b/T_b}}{6.29E+10E_cE_fE_AT_sF}$	4.30E-16	4.30E-16	2.64E-15	2.64E-15	8.08E-14	8.08E-14	3.99E-16 N/A	N/A
	β/γ		8.39E-15	8.39E-15	5.15E-14	5.15E-14	1.10E-12	1.10E-12	N/A	N/A
DAC	α	$DAC=\frac{\left(ACT\frac{\mu Ci}{mL}+1.645\sigma\right)}{\frac{\mu Ci}{ml \bullet DAC}}$	0.001	0.001	0.004	0.004	0.241	0.242	N/A	N/A
	β/γ		0.000	0.000	0.000	0.000	0.061	.061	N/A	N/A